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Inventor (first named):	ZHANG, Xinge
Group Art Unit:	1795
Examiner Name:	SIDDIQUEE, Muhammad S.
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I hereby certify that this document is being electronically transmitted on this date August 16, 2010 to the U.S. Patent and Trademark Office, Attention: Examiner Muhammed S. Siddiquee, at Group Art Unit 1795 in Alexandria, VA 22313-1450

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DATED: August 16, 2010

APPEAL BRIEF UNDER 37 C.F.R. 41.37
IN RESPONSE TO FINAL OFFICE ACTION MAILED OCTOBER 15, 2009

To: Assistant Commissioner for Patents
Alexandria, VA 22313-1450

Dear Sir or Madam:

Notice of Appeal was filed March 15, 2010.

Attached is a Petition for a Three-Month Extension of Time which will extend the time for response to August 16, 2010.

Applicants are providing an Appeal Brief under 37 C.F.R. 41.37(c)(1). Claims 8-22 are under appeal.

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Respectfully submitted,

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APPEAL BRIEF UNDER 37 C.F.R. 41.37(C)(1)

Applicants provide this Appeal Brief under 37 C.F.R. 41.37(c)(1). The fee for this Appeal Brief is $270.00 under 35 U.S.C. 41(a)(6)(B). Fee payment by Electronic means is transmitted herewith.

(i) Real Party in Interest

The real parties in interest are the applicants Xinge Zhang, Anthony Wood, and Michel Riou, and their assignee Versa Power Systems, Ltd.

(ii) Related Appeals and Interferences

There are no prior or other pending appeals, judicial proceedings or interferences known to the Appellant which may be related to, directly affect or be directly affected by or have any bearing on the Board's decision in the pending appeal.

(iii) Status of Claims

Claims 1-7 have been cancelled.

Claims 8-22 are rejected and are under appeal.

(iv) Status of Amendments

No amendments have been filed subsequent to the final rejection mailed October 15, 2009.

(v) Summary of Claimed Subject Matter

Independent claim 8 is directed to a fuel cell stack comprising a plurality of planar interleaved fuel cells and interconnects and comprising a contact layer disposed between at least one electrode of a fuel cell and an adjacent interconnect, the contact layer comprising at least two outer layers and a central layer of electrically conductive materials, the central layer disposed between the two outer layers, wherein the central layer comprises a stress relief layer comprised of material selected from the group consisting of:

- (a) particles of a conductive ceramic material which are coarser than in the outer layers;
- (b) particles of a conductive ceramic material which has significantly different sintering characteristics than the outer layers; and
- (c) a porous metallic material.

Elements of claim 8 are shown in Figures 1 and 2, and are described in the as-filed specification for example, on pages 4-8.

(vi) Grounds of Rejection to be Reviewed on Appeal

1. Whether claims 8-11, 13-14, 16 and 17 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* (DE 19627504).

2. Whether claims 12 and 15 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* as applied to claims 9 and 14, and in view of Tietz (US 2004/0047789).

3. Whether claims 18-20 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* as applied to claim 8 and in view of Tietz.

4. Whether claims 21 and 22 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* as applied to claim 16, and further in view of Ghosh *et al.* (US 2002/0122971).

(vii) Argument

The present invention is directed to a fuel cell stack comprising planar interleaved fuel cells and interconnect plates and a contact layer disposed between at least one electrode of a fuel cell and an adjacent interconnect plate. The contact layer is porous to permit the flow of reactant to the electrode, and comprises at least two outer layers and a central layer of electrically conductive materials disposed between the two outer layers. The central layer comprises a stress relief layer comprised of material selected from particles of a conductive ceramic material which are coarser than in the outer layers; particles of a conductive ceramic material which has significantly different sintering characteristics than the outer layers; or a porous metallic material.

Maintaining good electrical contact between the fuel cell electrodes and interconnect plates is essential in operating a fuel cell stack with high efficiency. Proper formulation and adhesion of contact pastes to the interconnect plates and fuel cell electrodes are vital to maintain electrical conductivity throughout the lifetime of the fuel cell stack after many thermal cycles. Further, contact pastes should be sufficiently porous to allow the flow of reactant to the electrode and the flow of by-products from the electrode, since areas where contact paste has become densified reduce the diffusion of reactant to the electrode and prevent the desired reactions.

It is well known that thermal cycling of fuel cells results in large thermal stresses. A serious drawback of prior art contact pastes is that they may break away from the fuel cells and interconnect plates, resulting in poor electrical contact and reducing cell performance. The problem is attributed to the different thermal expansion coefficients of the contact pastes and the fuel cell material; for example, the use of lanthanum cobaltate is undesirable since it has a coefficient of thermal expansion exceeding that of the fuel cell material.

The present invention seeks to provide a contact layer which exhibits superior interface performance with the fuel cell electrodes and interconnect plates, thereby maintaining electrical conductivity. The contact layer has been formulated to match the thermal expansion coefficient of the fuel cell material, to minimize interfacial contact failures, and to provide better resistance to thermal cycling degradation and long term degradation.

1. Whether claims 8-11, 13-14, 16 and 17 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* (DE 19627504).

Applicants respectfully traverse this rejection. The technical problem solved by Applicants' invention is to provide a contact layer which exhibits superior interface performance with the fuel cell electrodes and interconnect plates, thereby maintaining electrical conductivity and resisting degradation after many thermal cycles. The solution is achieved by providing a contact layer having at least two outer layers and a central "stress relief" layer of electrically conductive materials disposed between the two outer layers, as shown in Figures 2 and 3 and described on pages 4-8 of the specification. The stress relief layer comprises material selected from particles of a conductive ceramic material which are coarser than in the outer layers; particles of a conductive ceramic material which has significantly different sintering characteristics than the outer layers; or a porous metallic material.

This solution has considerable technical effects, as can be seen in Figure 3 which illustrates a scanning electron micrograph of an "autopsied" fuel cell. The contact layer is shown having the outer layers (100, 102) adhering to the fuel cell electrode and interconnect plate respectively, and the central layer comprising the stress relief layer (104). The stress relief layer serves as a "sacrificial" layer which is intentionally sandwiched between the outer layers (100, 102) to absorb physical stresses (i.e., expansion mismatches) which typically arise during thermal cycling and long term operation. As can be seen in Figure 3, there is a prominent horizontal fracture within the stress relief layer (104). However, despite the fracturing of the stress relief layer (104), the interfaces between outer layer (100) and the fuel cell electrode, and between outer layer (102) and the interconnect plate remain intact. Mechanical damage of the critical interfaces is thus avoided by positioning of the stress relief layer (104) between the outer layers (100, 102). Importantly, the electrical conductivity through the contact layer is maintained despite the presence of horizontal fractures. Positioning of the outer layers (100, 102) and central layer (104) thus amounts to more than mere rearrangement of parts and routine skill in the art, as stated by the Examiner.

Independent claim 8 explicitly recites language defining the positioning of the layers as follows:

- the contact layer comprising at least two outer layers and a central layer of electrically conductive materials.
- the central layer disposed between the two outer layers, wherein the central layer comprises a stress relief layer comprised of the recited materials.

In contrast to the presently claimed invention, Schmidt *et al.* teaches a lower oxidic layer (26) adhering to the interconnect plate (4), a middle ceramic layer (28) positioned above the lower oxidic layer (26), and an upper ceramic layer (30) positioned above the middle ceramic layer (28) and adhering to the electrode (6). The middle ceramic layer (28) exhibits less porosity than the upper ceramic layer (30) which displays greater porosity and comprises coarse particles.

Applicants respectfully submit that the Examiner fails to establish a *prima facie* case of obviousness against the presently claimed invention because Schmidt *et al.* does not teach or suggest each and every element of the claims. "To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." *In re Royka*, 490 F.2d. 981, 180 USPQ 580 (CCPA 1974). The Examiner equates the central layer (104) comprising coarse particles and disposed between the two outer layers (100, 102) of Applicants' claim 8 with the upper ceramic layer (30) comprising coarse particles of Schmidt *et al.* However, at best, Schmidt *et al.* teaches that the coarse particle layer (30) is actually one of the <u>outer</u> layers. This is an entirely different configuration from Applicants' claimed contact layer. The Examiner thus cannot reasonably consider the upper ceramic layer (30) as being "central" or "disposed between the two outer layers," as explicitly recited in Applicants' claim 8. Thus, the language of claim 8 distinguishes the teachings of Schmidt *et al.*

Schmidt *et al.* does not teach or suggest the claimed solution. As previously discussed, Applicants' positioning of the outer layers (100, 102) and central layer (104) has considerable technical effects including maintaining critical interfaces of the outer layers (100, 102) with the fuel cell electrode and interconnect plate, despite fracturing of the sacrificial central stress relief layer (104). With the positioning of the respective layers in Schmidt *et al.*, fracturing of the

coarse upper ceramic layer (30) may result in interfacial contact failure with the electrode (6) or middle ceramic layer (28), thereby disrupting cell operation and performance. It is clear that the teachings of Schmidt *et al.* cannot accomplish the claimed solution. Schmidt *et al.* does not disclose how this might be accomplished. As a result, Applicants believe that one skilled in the art would not be able to easily conceive of positioning a coarse stress relief layer within fine outer layers (in place of using a coarse layer as an outer layer above two fine layers as taught by Schmidt *et al.*) to achieve the desired results.

The Examiner alleges that "it would have been obvious for one skilled in the art at the time the invention was made to use the coarse material layer in the middle of the three layers as one of a limited number of alternatives for ordering three layers of material with a reasonable expectation of success." Applicants respectfully disagree. To say that it would be obvious to do so is mere speculation. Just because it is possible to do something does not mean that it is obvious to do so, and the citation of Schmidt *et al.* does not provide convincing evidence that one skilled in the art would be motivated to modify Schmidt *et al.*

At minimum, it must be demonstrated that the cited reference provides a sufficient basis to predictably arrive at the presently claimed invention, and even assuming, *arguendo*, that the cited reference teaches each claim feature, the Examiner must provide an explicit, apparent reason to combine these features in the fashion claimed by Applicants with a reasonable expectation of success (*KSR v. Teleflex, Inc.* "A patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art"). In the instant case, the Examiner has not provided any rationale to support why one skilled in the art would seek to formulate a contact layer comprising at least two outer layers and a central layer comprising a stress relief layer in the arrangement as claimed. In view of Schmidt *et al.* and the level and knowledge in the art, one skilled in the art would fail to predictably arrive at the presently claimed invention with any expectation of success, as is required under *KSR v. Teleflex, Inc.* Since the invention, as a whole, is not disclosed or suggested by Schmidt *et al.*, the present claims are unobvious. Therefore, the rejection of claims 8-11, 13-14, 16 and 17 should properly be withdrawn.

2. Whether claims 12 and 15 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* as applied to claims 9 and 14, and in view of Tietz (US 2004/0047789).

Applicants respectfully traverse this rejection. Claims 12 and 15 depend upon independent claim 8. Since Applicants believe that claim 8 patentably distinguishes over the prior art for the above reasons, there is no basis for rejection.

3. Whether claims 18-20 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* in view of Tietz.

Applicants respectfully traverse this rejection. Claims 18-20 depend upon independent claim 8. Since Applicants believe that claim 8 patentably distinguishes over the prior art for the above reasons, there is no basis for rejection.

4. Whether claims 21 and 22 are properly rejected under 35 U.S.C 103(a) as being unpatentable over Schmidt *et al.* as applied to claim 16, and further in view of Ghosh *et al.* (US 2002/0122971).

Applicants respectfully traverse this rejection. Claims 21 and 22 depend upon independent claim 8. Since Applicants believe that claim 8 patentably distinguishes over the prior art for the above reasons, there is no basis for rejection.

In view of the foregoing reasons, it is believed improper to reject any of claims 8-22 under 35 U.S.C. §103. The claimed invention is not a predictable use of prior art elements. Even if combined, the prior art does not yield the claimed invention or disclose each limitation in the claims. A *prime facie* case of obviousness has not been established. In summary, claims 8-22 are not believed to be anticipated or rendered obvious in view of the cited prior art. Reconsideration and withdrawal of all claim rejections under 35 U.S.C. §103, and allowance of claims 8-22 are thus respectfully requested.

(viii) Claims Appendix

8. A fuel cell stack comprising a plurality of planar interleaved fuel cells and interconnects and comprising a contact layer disposed between at least one electrode of a fuel cell and an adjacent interconnect, the contact layer comprising at least two outer layers and a central layer of electrically conductive materials, the central layer disposed between the two outer layers, wherein the central layer comprises a stress relief layer comprised of material selected from the group consisting of:

(a) particles of a conductive ceramic material which are coarser than in the outer layers;

(b) particles of a conductive ceramic material which has significantly different sintering characteristics than the outer layers; and

(c) a porous metallic material.

9. The fuel cell stack of claim 8 wherein the stress-relief layer comprises coarse particles and the outer layers comprises fine particles.

10. The fuel cell stack of claim 9 wherein the coarse particles have an average diameter at least about twice as large as the average diameter of the fine particles.

11. The fuel cell stack of claim 10 wherein the outer layers comprises particles having an average diameter of less than about 2 μm and the central layer comprises particles having a diameter of greater than about 2 μm.

12. The fuel cell stack of claim 9 wherein the central layer comprises lanthanum cobalt nickel oxide particles.

13. The fuel cell stack of claim 12 wherein the outer layers comprise lanthanum cobaltate particles.

14. The fuel cell stack of claim 8 wherein the outer layers comprise fine lanthanum cobaltate or lanthanum cobalt nickel oxide particles and the stress relief layer comprises fine lanthanum strontium manganite particles, or coarse lanthanum strontium manganite particles, or coarse lanthanum cobalt nickel oxide particles.

15. The fuel cell stack of claim 14 wherein a first outer layer contacting the electrode comprises fine lanthanum cobalt nickel oxide particles, a second outer layer contacting the interconnect comprises fine lanthanum cobaltate particles, and the stress relief layer comprises coarse lanthanum cobalt nickel oxide particles.

16. The fuel cell stack of claim 8 wherein any layer of the contact layer comprises a perovskite having the formula ABO_3 where:

(a) A is a doped or undoped rare earth metal or lanthanide;
(b) B is a doped or undoped transition metal; and
(c) wherein the perovskite is electrically conductive and has a coefficient of thermal expansion which closely matches that of the fuel cell.

17. The fuel cell stack of claim 16 wherein A comprises doped or undoped lanthanum.

18. The fuel cell stack of claim 17 wherein B comprises cobalt combined with nickel as follows: $Co_{1-y}Ni_y$ where $0.3 \leq y \leq 0.7$.

19. The fuel cell stack of claim 18 wherein the perovskite material comprises $La_{1-x}E_x Co_{0.6}Ni_{0.4}O_3$, where E is an alkaline earth metal and x is greater than or equal to zero.

20. The fuel cell stack of claim 16, 17, 18 or 19 wherein at least one dopant is a sintering aid.

21. The fuel cell stack of claim 16 wherein the electrode comprises a noble metal and yttria stabilized zirconia.

22. The fuel cell stack of claim 21 wherein the noble metal comprises palladium.

(ix) Evidence Appendix

None.

(x) Related Proceedings Appendix

None.